

Tj MAX LIMIT OF SCHOTTKY DIODES

B.Rivet

INTRODUCTION

This application note is about the limit of Tj max given in the datasheet of SCHOTTKY rectifiers.

It explains the real meaning of this parameter and why in some applications, the component can operate with a junction temperature higher than Tj max.

Table fig.1 shows the Tj max specified in the datasheet for the different families of SCHOTTKY diodes.

Fig.1 : Tj max versus SCHOTTKY family

SCHOTTKY FAMILY	V _{RRM} (V)	Tj Max (°C)
STPSxxL10	10	100
STPSxxL25	25	125
STPSxx45	45	150
STPSxx100	100	125

For a classical ultra fast rectifier, this limit is equal to 150°C. For a SCHOTTKY diode this limit is lower (for instance 125°C for a STPSxxL25). This lower limit of Tj max is only due to thermal runaway phenomenon linked to the leakage current.

This phenomenon is explained in the application note: "THERMAL RUNAWAY IN RECTIFIER".

This application note describes the rules for the calculation of the limit before thermal instability is reached. This limit depends on the characteristics of the diodes (leakage current : I_R, junction to case thermal resistance Rth(j-c) ...) and application parameters (reapplied voltage across the diodes : V_R, duty cycle of the blocking of the diode : (1 - δ), thermal resistance of the heatsink : Rth(c-a) ...).

The following two examples show that for the same diode (STPS10L25D) different conditions lead to different limits for Tj max.

First example :

Application parameters :

$$(1-\delta) = 0.5$$

$$V_R = 15V$$

$$R_{th}(c-a) = 8.5^{\circ}C/W$$

Diode parameters : (STPS10L25D) :

$$I_R \text{ max } (15V, 125^{\circ}C) = 210mA$$

$$R_{th}(j-c) = 1.6^{\circ}C/W$$

The limit of the reverse current at V_R and Tj max before reaching thermal runaway is given by :

$$I_R (15V, Tjmax) = \frac{1}{V_R (1-\delta) c R_{th}(j-a)}$$

Where c is a thermal coefficient c ≈ 0.055

$$R_{th}(j-a) = R_{th}(j-c) + R_{th}(c-a)$$

We have : I_R (15V, Tj max) = 242mA

Tj max is given by :

$$Tjmax = 125 + \frac{1}{c} \ln \frac{I_R (15V, Tjmax)}{I_R \text{ max } (15V, 125^{\circ}C)}$$

$$\mathbf{Tj \text{ max } = 127^{\circ}C}$$

Second example :

Application parameters :

$$(1-\delta) = 0.5$$

$$V_R = 5V$$

$$R_{th}(c-a) = 18.5^{\circ}C/W$$

Diode parameters (STPS10L25D) :

$$I_R \text{ max } (5V, 125^{\circ}C) = 125mA$$

$$R_{th}(c-a) = 1.6^{\circ}C/W$$

We have I_R (5V, Tj max) = 363mA

and **Tj max = 144°C**

APPLICATION NOTE

CONCLUSIONS :

This application note shows that the maximum limit of T_j of the SCHOTTKY diodes given in the datasheet is mainly due to the thermal runaway phenomenon. This limit doesn't only depend on diode parameters but also application parameters. In the first example corresponding to a typical application we will find T_j max given in the datasheet. The second example shows that in some applications SCHOTTKY diodes can be used with a junction temperature higher than the T_j max given in the datasheet.

Information furnished is believed to be accurate and reliable. However, SGS-THOMSON Microelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of SGS-THOMSON Microelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. SGS-THOMSON Microelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of SGS-THOMSON Microelectronics.

© 1996 SGS-THOMSON Microelectronics - Printed in Italy - All rights reserved.

SGS-THOMSON Microelectronics GROUP OF COMPANIES

Australia - Brazil - Canada - China - France - Germany - Hong Kong - Italy - Japan - Korea - Malaysia - Malta - Morocco -
The Netherlands - Singapore - Spain - Sweden - Switzerland - Taiwan - Thailand - United Kingdom - U.S.A.